

# Combining System Safety & Reliability to Ensure NASA CoNeCT's Success

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# Overview

## Communications, Navigation, and Networking reConfigurable Testbed (CoNNeCT)

- ◆ **Background**
- ◆ **Challenges and Complexities**
- ◆ **Importance of System Safety and Reliability**
- ◆ **Combining Applications**
- ◆ **Summary**
- ◆ **Future Work**



Flight System of CoNNeCT

# Background

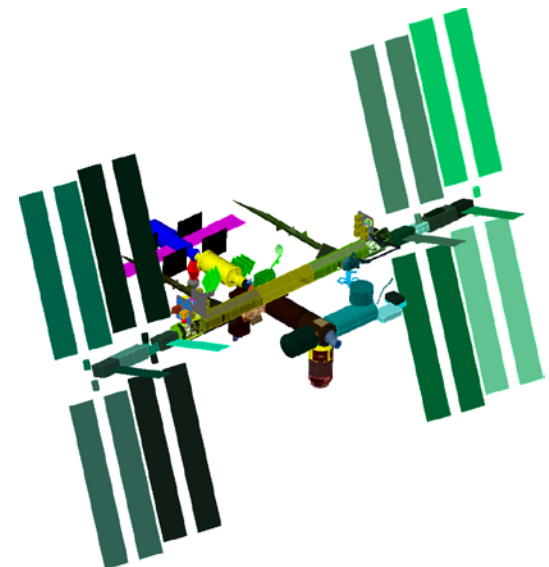
- ◆ **Purpose is to develop core facility capabilities that allow flexible experimentation and operations later**
  - Comparable to other International Space Station (ISS) facilities and follow-on experiments
  - Unique in that science team is like flight crew, but without pre-programmed script and unique utilization of Tracking and Data Relay Satellite System (TDRSS)
  - Operations from Glenn Research Center (GRC) Telescience Support Center (TSC)
  - Design/build accommodations around three Software Defined Radios (SDRs)
  
- ◆ **Multiple NASA Centers, Headquarters (HQ), industry partners and commercial vendors**
  - GRC, Jet Propulsion Laboratory (JPL), Goddard Space Flight Center (GSFC), Johnson Space Center (JSC), General Dynamics (GD), Harris Corp and SpaceDev

# Background, cont.

- ◆ **Protoflight development with hard schedule constraint**
  - Flight hardware accelerated at risk compared to classic 7120.5
- ◆ **Category 3 level project/Class D payload**
- ◆ **International Traffic in Arms Regulation (ITAR) Classification**
  - Payload/Ground Support Equipment (GSE) designated USML XV(e) and Software/Detailed Technical Data USML XV(f)

# Mission Description

- ◆ **CoNNeCT is the name of the project – SCAN Testbed is the Operations Nomenclature (OpNom) for the Flight System**
- ◆ **Launch to the ISS on a Japan Aerospace Exploration Agency (JAXA) H-II Transfer Vehicle (HTV-3) in 2012**
- ◆ **Carrier configuration is Flight Releasable Attachment Mechanism (FRAM)-based payload and installed on the Expedite the Processing of Experiments to Space Station (ExPRESS) Logistics Carrier (ELC) at the ISS P3 location**
- ◆ **The Flight System is a \$100M Class D payload designed to operate for a minimum of two years**
  - **Funded by NASA Headquarters**



# Challenges and Complexities

- ◆ **Proto-flight development with an aggressive schedule constraint**
- ◆ **Accelerated building and test of flight hardware and software**
- ◆ **International Space Station partners impacted by the success or failure of CoNNeCT**
  - JAXA, Canadian Space Agency (CSA), European Space Agency (ESA), and Russian Federal Space Agency (RKA, commonly called Roscosmos)
- ◆ **Design requirements defining safe radio frequency (RF) limits for Ka-Band emissions were concurrently being developed by the ISS program**

# Challenges and Complexities, cont.

- ◆ **SCAN Testbed software is developed by five organizations★:**

- Glenn Research Center (GRC)
- Goddard Space Flight Center (GSFC)
- Jet Propulsion Laboratory (JPL)
- General Dynamics (GD)
- Harris Corporation

- ◆ **System coordination of hardware that together comprises the SCAN Testbed comes from★:**

- GRC
- GSFC
- JPL
- GD
- Harris Corporation
- Sierra Nevada Corporation (SpaceDev)



# Importance of System Safety and Reliability

## ♦ **System Safety:**

- Radios with flexibility of signal configurations
- Ease of radio frequencies impact on other payloads, the ISS, the visiting vehicles, and the on-orbit crew

## ♦ **Reliability:**

- Need for reliable future space communication links
- Payload must function as advertised
- Impacts many different users on ISS



# Combining Applications

- ◆ **System Safety Assessments:**
  - Preliminary Hazard Analysis
  - Subsystem and System Hazard Analysis
- ◆ **System Safety Deliverables:**
  - Safety Data Packages
  - Hazard Reports
  - Noncompliance Reports (as needed)
- ◆ **Reliability Assessments and Deliverables:**
  - Failure Modes and Effects Analysis (functional)
  - Limited Life Items List
  - Single Point Failure List



# Summary

- ◆ **Were all hazards identified and mitigated?**
  - Assessments completed and presented to independent safety panels
  - New hazards that were discovered were worked immediately, with impacts to design, cost and schedule evaluated as part of the decision process
  - All safety requirements met, or waivers/deviations were handled per approved processes
  
- ◆ **Has the system been designed and constructed to meet the mission requirements?**
  - Potential weaknesses of the system were identified
  - Rationale for how the system could either be modified, tested, or accepted 'as is' was captured in the documentation

# Summary, cont.

## ♦ **How could we be better?**

- Improve stand-alone assessments with coordination of findings between the disciplines
- Other safety assessments, such as Fault Tree Analysis, may have identified failure modes that were experienced by the payload and not flagged by the existing assessments

# Future Work

- ◆ **New items learned by the system safety and reliability team during the development of this project:**
  - JAXA safety design and process requirements
  - RF limits for all ISS stationary hardware, visiting vehicles to ISS, on-orbit robotic equipment, and Extravehicular Activity (EVA) crews
  - ISS program processes for discussing and negotiating working solutions to safety or reliability issues
  - New failure modes for components and software
  - Difficulties that can occur when components and software for a system are provided by multiple parties
- ◆ **GRC system safety and reliability team gained valuable data that can be shared with discipline coworkers**

# Contact Information

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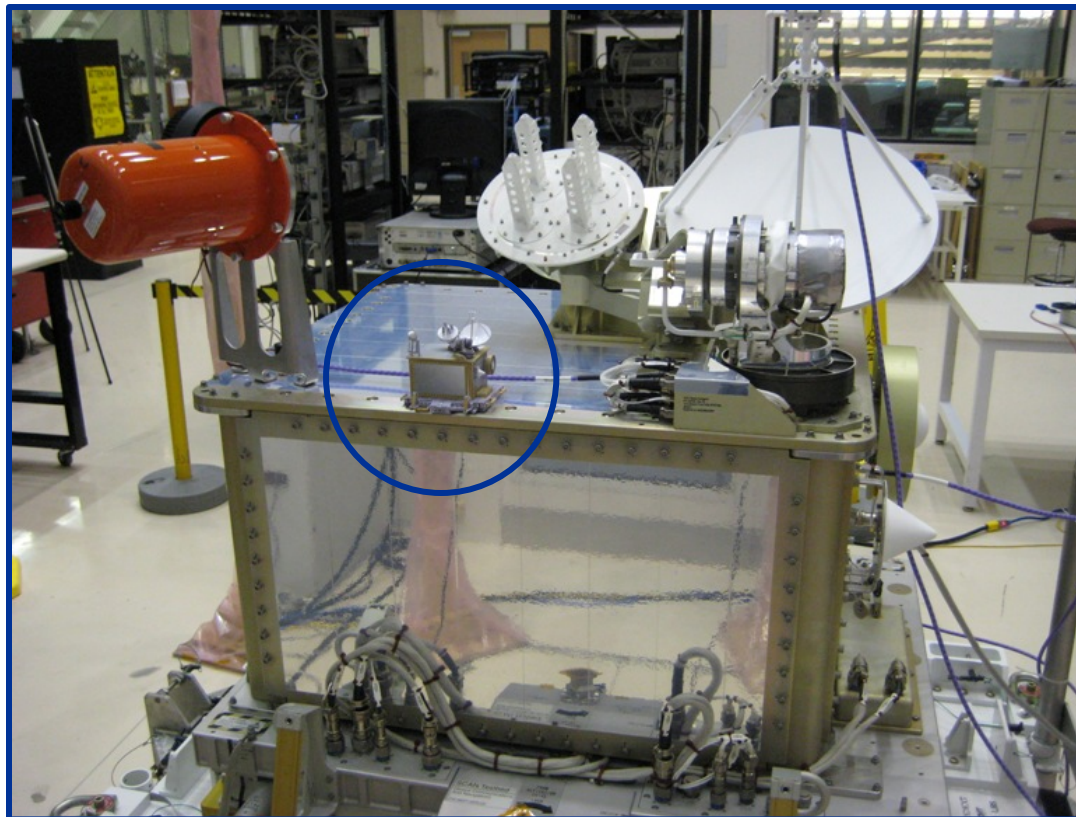
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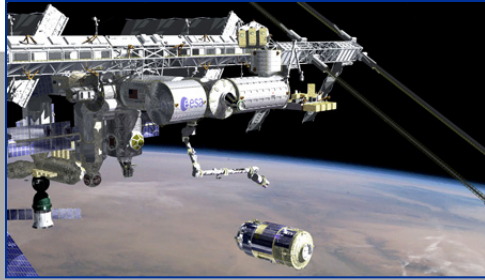
# Thank you!



# Backup



# Payload Delivered to ISS by JAXA



Payload will be EVR Installed  
on ELC3 on the ISS



Payload will be ground  
processed at, and launched  
from the Tanegashima Space  
Center in Japan and delivered  
to the ISS by the HTV

Payload will be processed for  
international shipping and customs at  
the Glenn Research Center

**JAPAN**

**US**



# SCAN Testbed on ISS/ELC-3

